

ANNEX NO. 1
BETWEEN
THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LANGLEY RESEARCH CENTER
AND
MISSISSIPPI STATE UNIVERSITY
UNDER
SPACE ACT UMBRELLA AGREEMENT SAA1-32662
FOR
STITCHED/RESIN-INFUSED COMPOSITES MATERIAL CHARACTERIZATION
AND SUB-COMPONENT DEVELOPMENT

ARTICLE 1. PURPOSE

The purpose of this Annex is to conduct research on stitched composite structures. Methods for the design, processing, and testing of stitched composites are greatly lacking. As NASA Langley Research Center (LaRC) and Mississippi State University (MSU) have similar interests in the area of stitched composite architectures, this Annex will facilitate collaboration and exchange of resources and capabilities. This Annex effort will concentrate on the fabrication and testing of stitched T-joints, which are critical structures for joining and assembly of advanced aerospace structures.

The legal authority for this Annex, consistent with the Umbrella Agreement, is in accordance with the National Aeronautics and Space Act (51 U.S.C. § 20113(e)).

ARTICLE 2. RESPONSIBILITIES

A. NASA LaRC will use reasonable efforts to:

1. Advise the ongoing study with regards to manufacture, testing and analysis. (Milestone 1)
2. Work with MSU to define designs for flat and T-joint test specimens. (Milestone 1)
3. Provide tooling for composite preform support during the stitching. (Milestone 4)
4. Provide tooling for infusion and cure for T-joint preforms. (Milestone 5)
5. Stitch flat specimens for testing of preliminary material data and impact response. (Milestone 6)
6. Stitch T-joint preforms for testing. (Milestone 6)
7. Conduct mechanical testing of T-joint specimens. (Milestone 9)
8. Conduct mechanical testing of flat specimens for characterization and impact response. (Milestone 9)
9. Document methods and results of research including preparing to publish in proceedings and/or journals. (Milestone 11)
10. Provide an educational experience and stitching training for students through student visits to LaRC. This will include office space and access to the Integrated Structural Assembly of Advanced Composites (ISAAC) robot and ISAAC personnel, and may

include an opportunity through the NASA Internships, Fellowships, and Scholarships (NIFS) or other similar program. (Milestone 10)

11. Ship items from LaRC to MSU. (Milestone 8)

B. MSU will use reasonable efforts to:

1. Work with LaRC to define designs for flat and T-joint test specimens. (Milestone 1)
2. The following fabrication materials for composite preform infusion and cure of the LaRC-provided flat and T-joint preforms may be provided by the MSU Advanced Composite Institute (ACI):

- (1) spool Vectran 800D Thread
- (1) 10' Carbon Fillet
- (1) 10' Pultruded Rod
- (1) roll of warp knit carbon (~40 yards)

Resin and other fabrication supplies will be subject to availability from MSU Aerospace Engineering Department and ACI. (Milestone 7)

3. Provide LaRC with CAD of chosen T-joint design(s). (Milestone 3)
4. Conduct mechanical tests of flat and T-joint test articles. (Milestone 9)
5. Document methods and results of research including preparing to publish in proceedings and/or journals. (Milestone 11)
6. Provide an opportunity for LaRC personnel to visit during infusion and cure of preforms. (Milestone 7)
7. Provide an educational experience and training for students through student visits to LaRC by providing information on qualified students. (Milestone 10)
8. Ship items from MSU to LaRC. (Milestone 8)

ARTICLE 3. SCHEDULE AND MILESTONES

The planned major milestones for the activities for this Annex defined in the "Responsibilities" Article are as follows:

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| 1. MSU and LaRC will agree upon final designs of test articles to be fabricated and tested. | Within twelve (12) weeks of effective date of Annex |
| 2. MSU will provide fabric, thread, noodle and Teflon tube materials to LaRC for preform stitching. | Within 6.5 months of effective date of Annex |
| 3. MSU will produce CAD files of the T-joint test specimen. | Within 8 months of effective date of Annex |
| 4. LaRC will provide support tooling to be used during stitching of T-joints. | Within 7.5 months of MSU providing CAD drawings to NASA LaRC |
| 5. LaRC will provide T-joint infusion and cure tools | Within 9.5 months of receiving |

to MSU.	material for stitching
6. LaRC will provide dry preforms of flat specimens and T-joints.	Within 9.5 months of receiving material for stitching
7. MSU will infuse and cure MSU and LaRC produced preforms for flat specimens and T-joints.	Within three (3) months of receiving infusion/cure tools and preforms
8. MSU will return cured flat and T-joint specimens to LaRC.	Within three (3) weeks of specimen cure
9. MSU and LaRC will test flat and T-joint specimens.	Within fourteen (20) months of effective date of Annex
10. LaRC will provide MSU student training for stitching at LaRC through opportunities such the NASA Internships, Fellowships, and Scholarships (NIFS) or other similar program (duration dependent on time of internship).	Within fourteen (20) months of effective date of Annex
11. MSU and LaRC will document results of this study.	Within fourteen (20) months of effective date of Annex

Milestones are based on normal operating conditions at LaRC and MSU. Should COVID-19 cause delays to the above milestones beyond 45 days for each milestone, LaRC and MSU will negotiate new mutually agreed upon milestone dates to be included in a modification to this Annex.

ARTICLE 4. FINANCIAL OBLIGATIONS

There will be no transfer of funds between the Parties under this Agreement and each Party will fund its own participation. All activities under or pursuant to this Agreement are subject to the availability of funds, and no provision of this Agreement shall be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, (31 U.S.C. § 1341).

ARTICLE 5. INTELLECTUAL PROPERTY RIGHTS - DATA RIGHTS

A. Data produced under this Annex which is subject to paragraph C. of the Intellectual Property Rights - Data Rights Article of the Umbrella Agreement will be protected for the period of two (2) years.

B. Under paragraph H. of the Intellectual Property Rights - Data Rights Article of the Umbrella Agreement, Disclosing Party provides the following Data to Receiving Party. The lists below may not be comprehensive, are subject to change, and do not supersede any restrictive notice on the Data provided.

1. Background Data: *The Disclosing Party's Background Data, if any, will be identified in a separate technical document.*
2. Third Party Proprietary Data: *The Disclosing Party's Third Party Proprietary Data, if any, will be identified in a separate technical document.*
3. Controlled Government Data: *The Disclosing Party's Controlled Government Data, if any, will be identified in a separate technical document.*
4. The following software and related Data will be provided to Partner under a separate Software Usage Agreement: *None.*

ARTICLE 6. TERM OF ANNEX

This Annex becomes effective upon the date of the last signature below ("Effective Date") and shall remain in effect until the completion of all obligations of both Parties hereto, or twenty months (20) from the Effective Date, whichever comes first, unless such term exceeds the duration of the Umbrella Agreement. The term of this Annex shall not exceed the term of the Umbrella Agreement. The Annex automatically expires upon the expiration of the Umbrella Agreement.

ARTICLE 7. RIGHT TO TERMINATE

Either Party may unilaterally terminate this Annex by providing thirty (30) calendar days written notice to the other Party.

ARTICLE 8. POINTS OF CONTACT

The following personnel are designated as the Points of Contact between the Parties in the performance of this Annex.

Management Points of Contact

NASA Langley Research Center
Andrew E. Lovejoy
Research Aerospace Engineer
Mail Stop: 190
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ARTICLE 9. MODIFICATIONS

Any modification to this Annex shall be executed, in writing, and signed by an authorized representative of NASA and the Partner. Modification of an Annex does not modify the terms of the Umbrella Agreement.

ARTICLE 10. SIGNATORY AUTHORITY

The signatories to this Annex covenant and certify that they have authority to execute this Annex. By signing below, the undersigned agrees to the above terms and conditions.

NATIONAL AERONAUTICS AND
SPACE ADMINISTRATION
LANGLEY RESEARCH CENTER

MISSISSIPPI STATE UNIVERSITY

BY: _____
Mary DiJoseph
Director, Aeronautics Research
Directorate

BY:  _____
Kevin Enroth
Director of Sponsored Programs

DATE: _____

DATE: 9.28.2020 _____